J. Perinat. Med.
7 (1979) 171

Investigation of some cord blood components

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The amount of blood which can be obtained from neonates is known to be very little, and is still less in premature infants. The question arises therefore whether cord blood screening of various components could be used for diagnostic purposes instead. To answer this question serial measurements and analysis of various components have been performed in a large population of infants.

Different lipid fractions of cord blood have been repeatedly measured by a number of authors with the aim of obtaining information on maternal and neonatal lipid metabolism [17]. Screening of cord blood lipids acquired special importance when it was found suitable for diagnosing familial hyperlipoproteinemias of which type II is the most frequent risk factor of ischemic heart disease. In a series of 1800 consecutive births GLUECK and coworkers [10] estimated the cord blood cholesterol concentrations. In 65 infants the values were higher than 100 mg/dl, and in 26 cases both parents were also followed up. Encouraged by their findings, the authors suggested the use of cord blood cholesterol estimations for screening purposes. A year later DARMADY and coworkers [7] published a report on a series of 302 infants and concluded that the diagnosis of familial hypercholesterolemia cannot be based on the analysis pf cord blood cholesterol levels. Controversy in this matter still exists although a number of studies have since been published.

Cord blood protein levels, too, have been investigated lately. Priority has been given to immunglobulins, from the estimation of which early detection of intrauterine infections calling for rapid intervention has been expected [1, 5, 13, 16]. Total protein estimations have been less numerous although these may supply useful information, and the techniques involved are simple and rapid.

The data available on cord blood calcium and magnesium levels are surprisingly scanty, although low serum calcium and/or magnesium concentrations have been supposed to play a role in neonatal afebrile convulsions and other pathological conditions. Neonatal hypocalcemia is relatively frequent in premature infants [24]. This has been investigated in several small series, in which changes in the serum concentration of calcium, mag-

Curriculum vitae

ADRIENNE STUBER, *born in Hungary in 1926, received her M.D. at the University of Budapest in 1950. She specialized in paediatrics and laboratory medicine, and obtained the scientific degree "Candidate of Medical Sciences" for research concerning the inborn errors of metabolism. Since 1967 she has been active as head physician of the Central Laboratory of* SCHÖPF-MEREI *Hospital and Center for Care of Mothers in Budapest, and is now working on questions of pre- and perinatal diagnostics.*

0300-5577/79/0007-0171$02.00

nesium and of hormones playing a role in the metabolism of these ions have been monitored in the cord blood of premature and term infants up to a few months of age [8, 14]. However, no vertical studies in large populations have so far been made.

We have, therefore, performed serial estimations of serum cholesterol, total lipid, total protein, calcium and magnesium in cord blood from serial births at both obstetric departments of SCHÖPF-MEREI Hospital and Center for Care of Mothers in the years 1975–76. The results were analysed by statistical methods.

1 Materials

From the two obstetric departments we received 3226 cord blood samples in 1975, and 3159 samples in 1976. Of these 98.7% and 99.0%, respectively, could be used for estimations.

With the samples information was also supplied on the date of the last menses of the mother, any disease during pregnancy, the neonate's APGAR value and birth weight. Based on these, the time of gestation and the birth weight percentile values were calculated. Morbidity (over 2500 g birth weight) and mortality (under 2500 g) during the first week of life were registered.

2 Methods

1. **Cholesterol** was estimated using RAPPAPORT's technique making use of the LIEBERMAN-BURCHARDT colour reaction.
2. **Total lipids** were analysed with the phosphoric acid-vanillin method.
3. **Total protein** was analysed using the biuret technique.
4. **Calcium** comcentration was estimated by colorimetric measuring of the Ca-phtalein complex.
5. **Magnesium** concentration was estimated by colorimetric measuring of the Mg-xylidil blue complex.

Statistical analysis of the methods is given in the appendix.

The clinical and biochemical data were filed on marginal punched cards.

To obtain homogenous populations, the infants were assigned into the following groups according to gestational age: 1. ⩽ 32 weeks of gestation; 33–37 weeks; 3. 38–42 weeks; 4. ⩾ 43 weeks. As shown by Fig. 1, in both series more than one-

	⩽ 32 g.w.	33 - 37 g.w.	38 - 42 g.w.	⩾ 43 g.w.	total
1975	284	587	2167	147	3185
1976	294	595	2140	99	3128

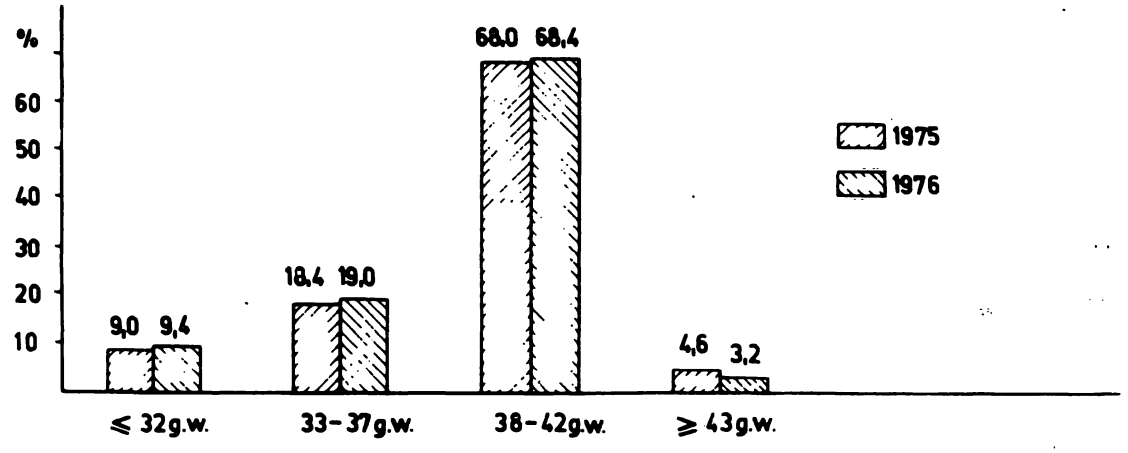

Fig. 1. Distribution of cord blood samples according to gestational age in the years 1975–76.

third of the cord blood samples derived from term infants.

To find out whether samples from infants of 38–42 weeks of gestation could be regarded as those of normal term infants, the frequency of maternal diseases affecting gestation was investigated in this group. Toxemia occured in 2,5% and 1,9% in the two series, respectively, diabetes was found in 0,4% and 0,3% respectively. Thus this group was considered to consist of healthy, mature infants.

3 Results

3.1 Cholesterol and total lipid

Fig. 2 shows the frequency distribution histogram of cholesterol values found in three groups of the 1975 series. Similar histograms were plotted for the 1976 series and for the total lipid values of both series. For all three groups the histograms show a moderate skewing to the right with a discrepancy of the mode and the median. Analysis of the goodness of fit had shown that the distribution was not a normal one. Therefore, the 10, 50 and 90 percentile values for cord blood cholesterol and total lipid in the individual gestational groups were calculated. As can be seen from Fig. 3, the 50 percentile values of both parameters were lowest in term infants.

To find out whether there was significant difference between the 50 percentile cholesterol values of the individual groups, logarithmic transformation of the data of the 1975 series was performed, and the mean values for each group were calculated:

1. ⩽ 32 weeks of gestation	84,4 mg/dl
2. 33–37 weeks	83,2 mg/dl
3. 38–42 weeks	76,2 mg/dl

As there was no significant difference between the two premature groups, their values were pooled for the **u** test. The value of **u** was 4,27 indicating strongly significant difference, i.e. a significantly higher cholesterol value in premature infants.

Apart from the post-term infants, the same gradual decrease was found with respect to the cord blood total lipid level.

3.2 Total protein

The distribution of the total protein levels was found approximately normal in term infants by the goodness of fit test. A definite skewing was, however, found in premature and the more so, the lower their gestational age was. Checking on GAUSS-paper yielded similar results (Fig. 4). The same kind of distribution was obtained in the 1976 series. Therefore, the 10, 50 and 90 percentile values were calculated (Fig. 3).

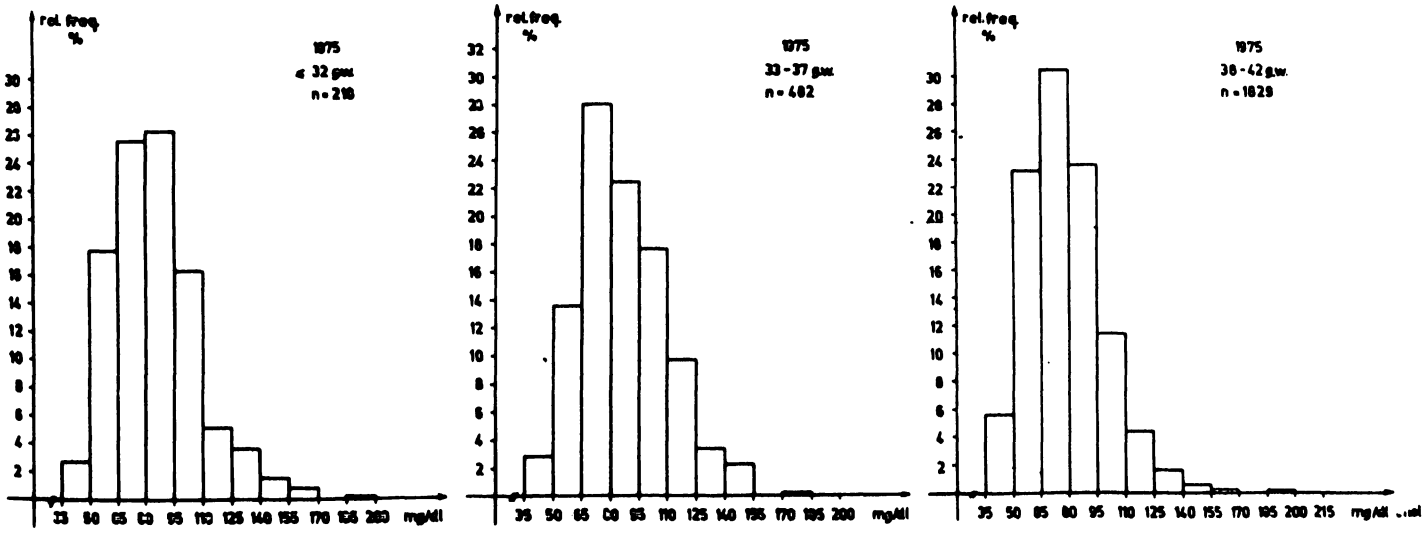

Fig. 2. Frequency histograms of cord blood cholesterol values at different gestational ages.

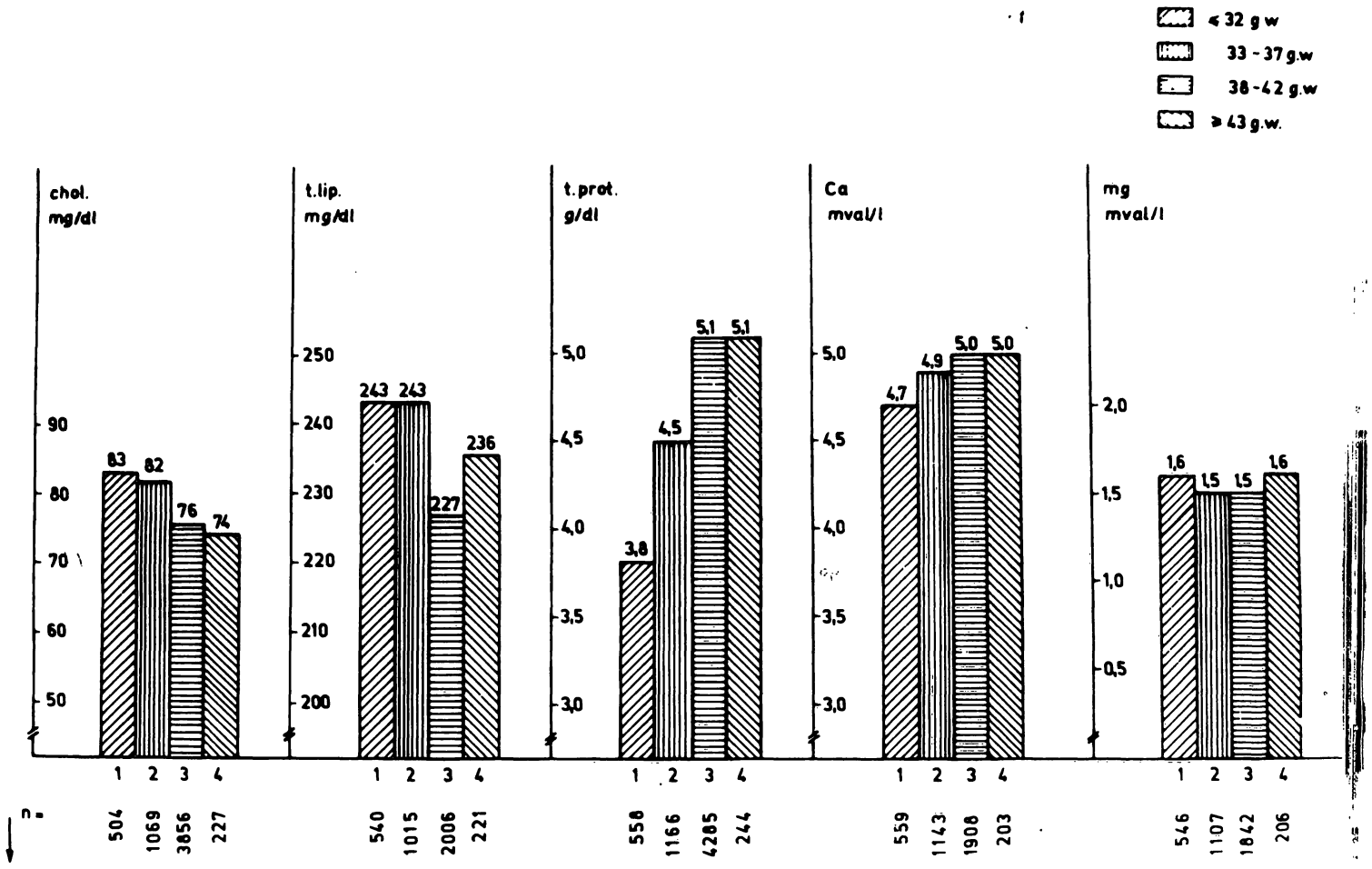

Fig. 3. 50 percentile values of cord blood cholesterol, total lipids, total protein, calcium and magnesium at different gestational ages.

For comparing the individual groups, log transformation was performed and the following means were calculated:

1. ⩽ 32 weeks of gestation	3,85 g/dl
2. 33–37 weeks	4,54 g/dl
3. 38–42 weeks	5,12 g/dl

Significance was estimated with the **u** test in two steps, yielding the following results: **u** = 12,4 for group 2 vs. group 1; **u** = 16,75 for group 3 vs. group 2. Strongly significant difference between the consecutive groups was thus found, and, therefore, the comparison of groups 1 and 3 omitted.

3.3 Calcium and magnesium

Since the histograms of the cord blood calcium and magnesium levels in the individual gestational groups failed to show normal distribution, the 10, 50, and 90 percentile values were calculated. The 50 percentiles are shown in Fig. 3. Cord blood calcium levels were found to increase along with the time of gestation, even if the rise was not as marked as in the case of the total protein level.

After log transformation the following mean calcium concentrations were obtained:

1. ⩽ 32 weeks of gestation	4,70 mval/l
2. 33–37 weeks	4,86 mval/l
3. 38–42 weeks	4,90 mval/l

Comparing the individual groups by help of the **u** test, the following values were obtained:

group 3 vs. group 2	**u** = 1,27/non-significant/
group 3 vs. group 1	**u** = 4,96/significant/
group 2 vs. group 1	**u** = 3,75/significant/

Thus a strongly significant difference was found between the cord blood calcium levels of term and the younger premature infants, and the concentration in the more mature infants of group 2 was still significantly higher than in the prematures of group 1.

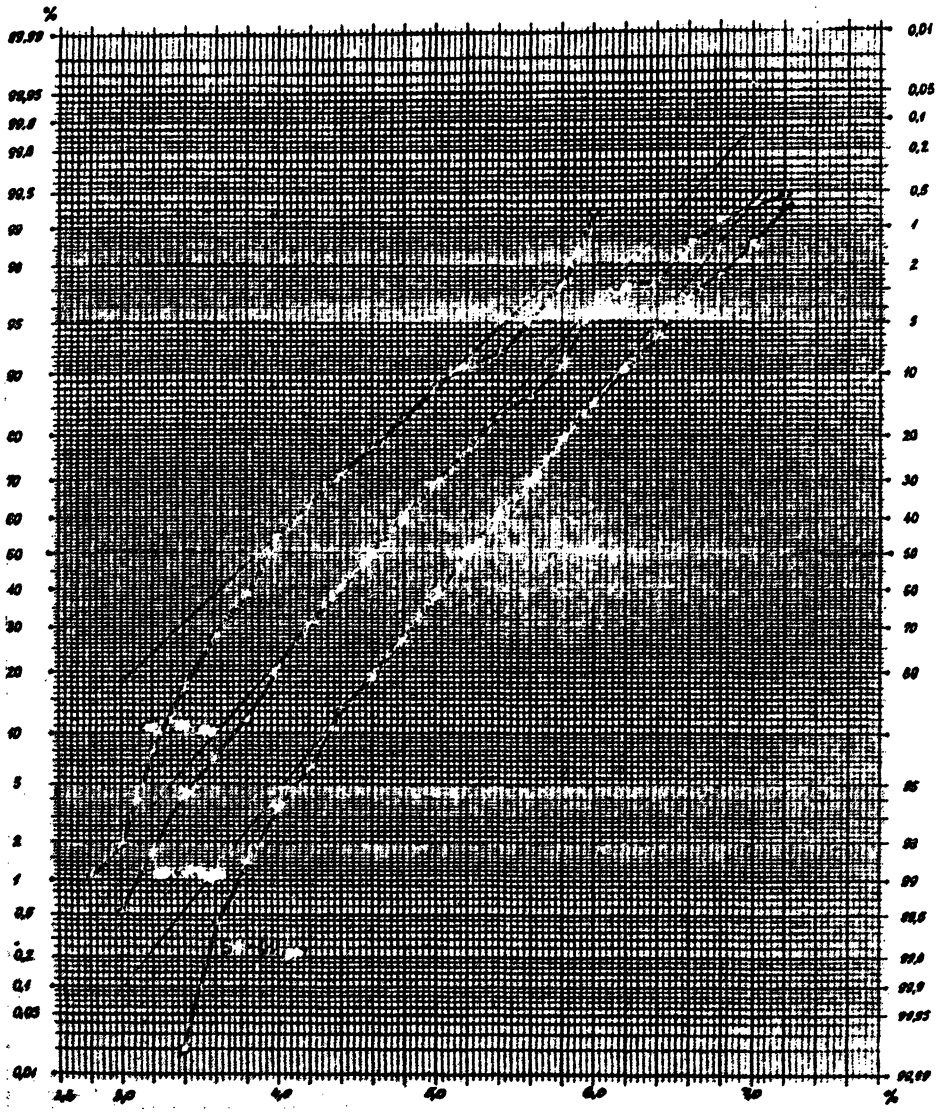

Fig. 4. Comparison of cumulative distribution of cord blood total protein values at different gestational ages.

Fig. 3 also carries the results of cord blood magnesium estimations. The 50 percentile values ranges from 1,5 to 1,6 mval/l, and no significant difference between the individual groups was found.

3.4 Comparison of the biochemical parameters with clinical data

To establish the importance in perinatal diagnostics of the biochemical parameters monitored, the frequency of pathological clinical findings was correlated with that of the abnormal biochemical parameters.

The first column of Tab. I shows the morbidity (Over 2500 g birth weight) and mortality (below 2500 g birth weight) rates in the first week of life as well as the frequency of APGAR values lower than 8 in the different gestational groups. The same clinical parameters were analysed in correlation with the pathologically high or low biochemical parameters.

In the second column of Tab. I the correlation of the clinical parameters with cord blood cholesterol levels higher than the 90 percentile value is shown. No parallelism had emerged from the comparison: in the group of term infants morbidity was higher among the hypercholesterolemic cases, whereas in both premature groups the morbidity and mortality rates of these infants were relatively lower. The frequency of low APGAR values was

Tab. I. Correlation between clinical parameters and pathological values of cord blood cholesterol, total protein, calcium and magnesium.

		% of total group	% of chol. > 90 p	% of t.prot. < 10 p	% of Ca < 10 p	% of Mg < 10 p
Morbidity mortality	⩾ 43 g.w.	6.3	0	24.0	0	0
	38–42 g.w.	5.5	8.0	8.8	5.7	5.2
	33–37 g.w.	11.6	5.6	17.1	12.7	11.7
	⩽ 32 g.w.	21.4	11.4	56.7	43.8	26.8
APGAR < 8	⩾ 43 g.w.	4.5	0	13.9	0	0
	38–42 g.w.	3.8	6.1	4.0	5.6	6.9
	33–37 g.w.	18.6	30.5	27.4	21.2	11.0
	⩽ 32 g.w.	71.5	59.5	82.3	73.2	57.5

less among the hypercholesterolemic infants of group 1, and higher in those of the other two groups, than in the total gestational groups. Notably, in the group of post-term infants there was no disease or low APGAR value among the hypercholesterolemic cases; however, the number of infants in this group was relatively low.

Similar results were obtained when comparing the clinical data with the cord blood total lipid values.

The third column of Tab. I shows the correlation between low (less than 10 percentile) total protein levels and the clinical data. In the group of term infants no correlation could be found between the low APGAR values and hypoproteinemia. However, among the prematures the occurence of low APGAR values along with decreased total protein levels was a rather frequent finding. Morbidity and mortality rates were, in all the groups higher in the hypoproteinemic infants than in the corresponding total groups. In the group of infants older than 43 weeks of gestation, notably, both the low APGAR values and morbidity were more frequent among the hypoproteinemic cases.

A higher mortality rate concurrent with low (under the 10 percentile value) calcium levels was only found in the prematures of group 1. In the other two groups the morbidity and mortality rates of hypocalcemics did not much differ from those found in the respective total groups. The low APGAR values failed to show any correlation with hypocalcemia (fourth column in Tab. I).

Finally, as shown in the last column of Tab. I, no appreciable correlation appeared between the clinical data and magnesium concentration.

3.5 The biochemical parameters in the cord blood of small-for-date infants

In infants of 38–42 weeks of gestation with birth weights below the 10 percentile value (small-for-date) the 50 percentile values of the biochemical parameters measured were compared with those obtained in the total group of term infants (Tab. II). No difference between the two populations was found with respect to any of the parameters. This also shows that small-for-dates are different from premature infants in spite of their low birth weight.

4 Discussion

4.1 Cholesterol and total lipids

Several papers have dealt with cord blood cholesterol estimations and the mean values reported range from 60 to 82 mg/dl in the studies published between 1970 and 1977 [7, 8, 10, 11, 12, 13, 15, 18, 20]. According to MISHKEL [17], this discrepancy is due to various (ethnic, nutritional,

Tab. II. Comparison of 50 percentile cord blood values of small-for-date and normal infants.

	Small-for-date		Normal	
	n	value	n	value
Cholesterol	361	76,36	3856	76,30
Total lipids	303	230,00	2006	227,00
Total protein	396	5,03	4285	5,10
Calcium	253	4,83	1908	5,03
Magnesium	297	1,57	1842	1,52

geographical, etc.) factors. The normal range is, however, much less divergent if only these data are considered which have been adjusted to the gestational age of the infants: a mean of 70,3 mg/dl at 38–43 weeks according to MISHKEL; 77,0 mg/dl 50 percentile value at 40 ± 2 weeks by DYEBERG [9]; and 76,2 mg/dl mean and 76,4 mg/dl 50 percentile at 38–42 weeks in our series. In spite of the existing geographical, nutritional, etc. differences, these mean values do not vary considerably.

In the literature we have not found any age-adjusted data of cord blood cholesterol concentration. **In our series significant difference was obtained between the cord blood cholesterol levels of premature and term infants.** This means that the 90 or 95 percentile value, which can be considered the upper limit of normality, is higher in the case of premature infants.

We have found no correlation between the elevation of some lipid factors in cord blood and perinatal stress. TSANG and coworkers [23] reported on elevated cord blood triglyceride levels, while CRESS and coworkers [4] found hypercholesterolemia in cases of maternal or infant disease. We, however, failed to demonstrate a correlation between levels of cord blood cholesterol over the 90 percentile on the one hand, and infant disease or low APGAR values, on the other. Further studies are, therefore, needed to judge the prognostic value of cord blood cholesterol estimations.

The number of data referring to the cord blood total lipid level are much less numerous in the literature. Based on 120 cases, DYEBERG and coworkers [9] established a 50 percentile value of 252 mg/dl. Our own findings of 227 mg/dl did not much differ from that, whereas the 293 mg/dl of MORTIMER [18], a mean of 20 cases, is a much higher value.

Since the total lipid fraction of cord blood is composed of many fractions, the diagnostic importance of its screening is less than that of cholesterol. Nevertheless, it is remarkable that in both series a parallelism was found between cholesterol and total lipid changes in both premature and term infants. However, in the group of post-term infants elevation of the total lipid concentration was found along with a decreasing cholesterol level, owing probably to an increase of other lipid factors.

4.2 Total protein

The estimation of total protein in cord blood is an easy and rapid procedure, which has so far failed to attract attention. Mass estimations would be needed to establish its practical value. **A close correlation was found between the total protein level in cord blood and the gestational age.** Comparison with the clinical data has shown that premature infants with cord blood total protein levels below the lo percentile value are more susceptible to disease. This estimation appears to be suitable for introduction into routine use, and premature infants with low values ought to be kept under close observation.

BLAND [2] as well as SINGER [21] have called attention to the more frequent occurence of RDS with poor prognosis among infants with cord blood total protein levels below 4,6 g/dl. This is understandable considering, that we, too, regularly found lower total protein levels in prematures. The lower limit of normality should, however, always be adjusted to the gestational age.

With the total protein estimations fresh evidence has been obtained for the difference existing between small-for-dates and prematures, also from the biochemical point of view.

4.3 Calcium and magnesium

The mean cord blood calcium concentration was found to be 5,16 mval/l by STOBER [22] in 95 infants. HILLMAN and coworkers [14] measured a mean calcium level of 5,12 mval/l in 10 term infants. DAVID and coworkers [8] found it 5,4 mval/l in 31 cases of term infants and 4,3 mval/l in 7 prematures. Although the number of DAVID's cases was small, he, too, found **lower values in prematures.** Protein-bound calcium is mainly found in conjunction with albumin [20], and DAVID has established a connection between low calcium levels and hypoproteinemia. Our findings have also corroborated these speculations. Since it is the ionized calcium fraction which

plays a role in neonatal convulsion, cord blood total calcium estimations seem to have no prognostic value.

The present series of cord blood magnesium estimations have unequivocally proved that changes of the **magnesium level are independent of the gestational age.** A close connection between calcium and magnesium metabolism has been emphasized by TSANG and coworkers [24]. Thus magnesium concentrations below the 10 percentile value might possibly be used in the diagnosis of neonatal hypocalcemia or similar disorders. Further studies are, however, needed along these lines. The clinical parameters monitored in the present study were not consistently higher in cases with low calcium and magnesium concentrations (below the 10 percentile value).

Our cord blood magnesium estimations yielded results similar to those found in the literature: 1,47 mval/l [22], 1,62 mval/l [3], 1,5 mval/l [8], and 1,49–1,65 mval/l in the present series. DAVID found lower concentrations (1,25 mval/l) in a small population of prematures, nevertheless our data failed to substantiate his finding.

5 Conclusions

The prectical result borne by our investigations has been the introduction of routine estimation of cord blood total protein. In every case when the concentration is below the 10 percentile value, the clinicians are warned.

Further catamnestic studies are needed to judge the values of cord blood cholesterol estimations in screening for familial hyperlipoproteinemias. The hypercholeterolemic infants of the present series, who are 2–3 years old at present, as well as their families must be subjected to repeat analysis.

The change in opposite directions of cord blood total protein and cholesterol levels with the advance of gestation was a remarkable finding. This correlation indicates a close interaction between protein and lipid metabolism.

Less promising results have been obtained in investigations of the cord blood calcium and magnesium levels, but final conclusions can only be drawn after repeat analyses. Introduction of the routine estimation of these two parameters does not seem necessary at present.

Besides clinical data, biochemical parameters have also been found suitable for differentiating small-for-date infants from true prematures. The functional maturity of these infants was shown by the fact that their different cord blood components were normal.

6 Appendix

Statistical analysis of the used methods

Cholesterol:
Standard: 100 mg/dl cholesterol diluted in acetic acid
Interval of cal.curve: 50–100 mg/dl
Precision: S.D. ± 9,7 mg/dl c.o.v. 7,3%
Sensitivity: 7,4 mg/dl
Eq. of regression line: $y_i = 3{,}76 + 0{,}964x_i$
Corr. coeff.: r = 0.998

Total lipids:
Standard: mixed serum
Interval of cal. curve: 50–500 mg/dl
Precision: S.D. ± 18,3 mg/dl c.o.v. 9,2%
Sensitivity: 18,8 mg/dl
Eq. of regression line: $y_i = -2{,}34 + 1{,}004x_i$
Corr. coeff.: r = 0,998

Total protein:
Standard: mixed serum
Interval of cal. curve: 2,0–8,0 g/dl
Precision: S.D. ± 0,11 g/dl c.o.v. 1,9%
Sensitivity: 0,23 g/dl
Eq. of regression line: $y_i = -0{,}22+1{,}029x_i$
Corr. coeff.: r = 0,998

Calcium:
Standard: 5,0 mval/l Ca sol. containing 1,5 mval/l Mg
Interval of cal.curve: 2,5–7,5 mval/l
Precision: S.D. ± 0,086 mval/l c.o.v. 1,8%
Sensitivity: 0,15 mval/l
Eq. of regression line: $y_i = -0{,}015 + 0{,}993x_i$
Corr. coeff.: r = 0,999

Magnesium:
Standard: 2,0 mval/l acqueous Mg solution
Interval of cal. curve: 1,0–3,0 mval/l
Precision: S.D. ± 0,05 mval/l c.o.v. 3,0%
Sensitivity: 0,12 mval/l
Eq. of regression line: $y_i = 0{,}10+0{,}913x_i$
Corr. coeff.: r = 0.997

Summary

Serial estimations of various cord blood components were performed in neonates born in 1975 and 1976. In the two series several thousand measurements of cord blood cholesterol, total lipid, total protein, calcium and magnesium were done. The data were grouped according to gestational age into two premature, one term, and one post-term groups. Histograms of frequency distribution were drawn and the 10, 50 and 90 percentile values calculated.

Cord blood cholesterol concentration was found to decrease with the advance of gestation, whereas the value of total proteins increased. The total lipid level declined concurrently with the cholesterol level, though the decrease was somewhat less marked; and the calcium concentration increased along with the total protein. No difference between the magnesium concentrations of the four gestational groups was found.

The u test showed significantly higher cholesterol levels in both premature groups than in the group of term infants. No significant difference was found between the two premature groups. The difference between consecutive groups was invariably significant in respect of the cord blood total protein values, as shown by the u test. The calcium level was significantly lower only in the least mature infants as compared with the group of term neonates.

To obtain information on the practical value of the estimation of various cord blood components, the morbidity and mortality rates and the frequency of APGAR values below 8 in the study population were established, followed by analysis of the same parameters in the infants with cord blood cholesterol and total lipid values higher than the 90 percentile value and in those with total protein, calcium and magnesium levels below the 10 percentile value. **(No correlation was found with the abnormal levels of the lipid fractions, calcium and magnesium, whereas infantile disease or death was found to occur more frequently in infants with low total protein concentrations in all gestational groups. A similar correlation was found between low APGAR values and low total protein levels,** except for the group of term infants. This finding has lead to the introduction of screening of infants for low total protein levels of cord blood.

Analysis of cord blood specimens of small-for-date infants as regards all five components yielded results that were very close to those obtained in mature term infants.

Keywords: Calcium, cholesterol, cord blood, gestational age, magnesium, total lipids, protein.

Zusammenfassung

Bestimmung einiger Inhaltsstoffe des Nabelschnurblutes

Es wurden Serienmessungen verschiedener Komponenten im Nabelschnurblut von Neugeborenen der Jahrgänge 1975 und 1976 durchgeführt. Dabei bestimmten wir in mehrern tausend Fällen den Gehalt an Cholesterol, Gesamtlipiden, Gesamtproteinen, Calcium und Magnesium. Die gewonnenen Daten wurden entsprechend dem Gestationsalter zum Geburtszeitpunkt 4 Gruppen zugeordnet: zwei Gruppen mit vorzeitig geborenen Kindern, eine Gruppe mit Geburten am Termin und eine weitere Gruppe, in der die Kinder übertragen waren. Es wurden Häufigkeitsverteilungen aufgestellt sowie die 10- er, 50- er und 90-er Perzentilen bestimmt.

Cholesterol im Nabelschnurblut nahm mit zunehmendem Schwangerschaftsalter ab, während der Gesamtproteingehalt anstieg. Gleichzeitig mit dem Cholesterolspiegel sank auch der Gehalt an Gesamtlipiden, wobei dieser Abfall nicht ganz so deutlich war. Mit dem Anstieg der Gesamtproteine ging auch eine Zunahme der Calciumkonzentration einher. Auf Magnesium bezogen, ergaben sich keine Konzentrationsunterschiede in Abhängigkeit von der Länge der Schwangerschaft.

Bei den Frühgeborenen ließ sich mit dem U-Test ein signifikant höherer Cholesterolspiegel gegenüber den Geburten am Termin bestätigen. Zwischen den beiden Frühgeborenengruppen fand sich kein signifikanter Unterschied. Hinsichtlich des Proteingehaltes ließen sich mit dem U-Test zwischen allen Gruppen in Abhängigkeit von der Länge der Schwangerschaft signifikante Unterschiede feststellen. Ein signifikant niedriger Calciumspiegel hingegen ließ sich nur in der Gruppe der Frühgeborenen mit der geringsten Reife gegenüber Neugeborenen am Termin nachweisen.

Um den praktischen Nutzen einer Messung verschiedener Komponenten im Nabelschnurblut abschätzen zu können, wurden die Morbiditäts- und Mortalitätsrate sowie die Häufigkeit von APGAR-Werten unter 8 bestimmt. Eine Analyse der genannten Parameter erfolgte dann bei den Kindern, wo der Cholesterol- und der Gesamtlipidgehalt über der 90- er Perzentile lagen bzw. die Gesamtprotein-, Calcium- und Magnesiumkonzentration die 10- er Perzentile unterschritt. **Ein abnormer Lipid-, Calcium- oder auch Magnesiumspiegel korrelierte hierbei nicht mit einer Veränderung der Parameter Morbidität und Mortalität oder mit einem abweichenden APGAR-Wert. Jedoch zeigte sich, daß eine große Abhängigkeit zwischen niedrigen Proteinkonzentrationen und hohen Morbiditäts- bzw. Mortalitätsraten bestand. Ebenso korrelierte in hohem Maße ein niedriger Proteinspiegel mit einem herabgesetztem APGAR-Wert.** Dies gilt allerdings nicht bei den am Termin geborenen Kindern. Diese Ergebnisse haben uns veranlaßt, ein Screening-Verfahren einzuführen, um Kinder auf einen niedrigen Gesamtproteingehalt im Nabelschnurblut hin zu überprüfen.

Die Bestimmung von Inhaltsstoffen im Nabelschnurblut von Small-for-date Babies ergab in Hinblick auf alle fünf untersuchten Komponenten Resultate, wie sie auch bei Neugeborenen am Termin gefunden wurden.

Schlüsselwörter: Calcium, Cholesterol, Gesamtlipide, Gesamtproteine, Gestationsalter, Magnesium, Nabelschnurblut.

Résumé

Investigation des divers composants du sang du cordon ombilical

Des séries d'évaluations des divers composants du sang du cordon ombilical ont été effectuées chez des neonates nés en 1975 et 1976. Dans les deux séries, on a réalisé plusieurs milliers de mesures du cholestérol, des lipides complets, des protéines totales, du calcium et du magnésium dans le sang du cordon ombilical. Les données ont été regroupées selon l'âge de gestation en deux groupes de prématurés, un groupe à terme et un groupe après-terme. On a établi des histogrammes de distribution de fréquence et calculé les valeurs de 10, 50 et 90 percentiles.

Il est apparu que la concentration de cholestérol dans le sang du cordon ombilical baisse avec l'avance de la gestation, tandis qu'augmente la valeur des protéines totales. Le degré des lipides complets a diminué concurremment avec celui du cholestérol, bien que cette baisse ait été un peu moins forte; et la concentration de calcium a augmenté parallélement à celle des protéines totales. On n'a relevé aucune différence entre les concentrations de magnésium des quatre groupes gestationnels.

Le u test a montré des degrés de cholestérol nettement plus élevés dans les deux groupes prématurés que dans le groupe des enfants nés a terme. Aucune différence significative n'est apparue entre les deux groupes de prématurés. La différence entre les groupes consécutifs a été invariablement significative en ce qui concerne les valeurs de protéines totales du sang du cordon ombilical, ainsi qu'il est apparu dans le u test. Le degré de calcium a été nettement inférieur seulement chez les enfants les moins natures en comparaison avec les neonates nés à terme.

Afin d'établir la valeur pratique de l'estimation des divers composants du sang du cordon ombilical, nous avons défini les taux de morbidité et de mortalité et la fréquence des valeurs APGAR au-dessous de 8 dans la population examinée et analysé les mêmes paramètres chez les bébés dont les valeurs de cholestérol et de lipides complets du sang du cordon ombilical étaient supérieures aux valeurs de 90 percentiles et chez ceux dont les degrés de protéines totales, de calcium et de magnésium étaient inférieurs à la valeur de 10 percentiles. Nous n.avons trouvé aucune corrélation avec les degrés anormaux des fractions de lipide, de calcium et de magnçsium, tandis que nous avons constaté une fréquence supérieure de maladie oü de mort infantiles chez les bébés de tous les groupes gestationnels ayant des concentrations faibles de protéines totales' Nous avons observé une corrélation similaire entre les valeurs faibles d.APGAR et les degrçs faibles de protçines totales, à l'exception du groupe des bébés nés à terme. Ce résultat nous a amenés à introduire le dépistage de degrés faibles des protéines totales dans le sang du cordon ombilical.

L'analyse de spécimens de sang du cordon ombilical chez les bébés «small-for-date» pour l'examen des cinq composants a donné des résultats très rapprochés de ceux obtenus chez les bébés matures.

Mots-clés: Age de gestation, calcium, cholestérol, lipides complets, magnésium, protéines totales, sang du cordon ombilical.

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Received August 22, 1978. Accepted February 9, 1979.

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